Contract Report
November 1999

The CADD/GIS Technology Center
for facilities, infrastructure, and environment

Spatial Data Standards (SDS)
and
Facility Management Standards (FMS)

Flora and Fauna Entity Set Research and Analysis

Final Draft for Review

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Waterways Experiment Station Cataloging-in-Publication Data

Contents

Preface

This document provides a discussion of the research and evaluation processes associated with the preparation of a comparison f the available flora and fauna data models and the Spatial Data Standards/Facilities Management Standards (SDS/FMS), Release 1.8 (Tri-Service Spatial Data Standards (TSSDS)/Tri-Service Facility Management Standards (TSFMS).

The analysis includes matrix comparisons for content from all available models. Recommendations are provided for the expansion of the SDS/FMS, in a homogenous manner, to incorporate these other geospatial data models and database schemas as they pertain to the natural resources of flora and fauna entity sets. This report constitutes a continual and on-going process of research.

This report is a product of The CADD/GIS Technology Center located at the Information Technology Laboratory (ITL), U. S. Army Engineer Research and Development Center at Waterways Experiment Stations (WES), Vicksburg, Mississippi. This report was prepared by Ms Julie Pitts, Baker GeoResearch, Inc. Individual contributions were made by Mr. Ken Bristol, Eglin AFB and Ms Laurel Gorman, The CADD/GIS Technology Center. Ms Laurel Gorman was the CADD/GIS Technology Center technical point-of-contact (POC).

The Center operates under the guidance of Colonel Robin R. Cababa, Commander and Deputy Director of the U. S. Army Engineer Waterways Experiment Station and Mr. Harold Smith, Chief, The CADD/GIS Technology Center. The Center functions under the guidance of several oversight committees, including the Executive Steering Group (ESG), Executive Working Group (EWG), Field Technical Advisory Group (FTAG) and the Natural and Cultural Resources Field Working Group. The Natural and Cultural Field User

Group served as the project sponsor and provided technical guidance for the project. Members of these groups are listed below.

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Carl Enson	Member	Corps of Engineers
Gary Erickson	Member	Air Force
Dr. Get Moy	Member	Navy
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Christopher Kyberg	Member	Navy
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Lonnie Mettler	Vice-Chair	Corps of Engineers
Kenneth Bristol	Member	Air Force
Paul R. Green	Member	Air Force
Tad Britt	Member	Corps of Engineers
Clifford T. Brown	Member	Navy
Ronald Johnson	Member	Navy
Kevin G. Porteck	Alternate	Air Force
Randy Lierly	Assoc_Member	Air Force
Laurel Gorman	Facilitator	CADD/GIS Center

The authors acknowledge the contributions of many agencies who have developed and applied flora and fauna database models described in this report. Their insights and interest in this study are greatly appreciated. The contents of this report are not to be used for advertising, publication, or promotional purposes. Citation of trade names does not constitute an official endorsement or approval of the use of such commercial products. During the publication of this report COL. Robin R. Cababa was the Commander.

1 Introduction

This document compiles, researches, and evaluates selected flora and fauna entity set geospatial data requirements and compares the results to the Spatial Data Standards/Facilities Management Standards (SDS/FMS), release 1.8. This report was prepared by the Baker GeoResearch, Inc. (BGRI) 2925 Layfair Drive, Jackson, Mississippi 39208, through Contract No. DACA39-96-D-005 with The CADD/GIS Technology Center, U.S. Army Engineer Waterways Experiment Station (WES), 3909 Halls Ferry Road, Vicksburg, Mississippi 39108-6199.

Purpose

The purpose of this project is to review and evaluate the selected Geographical Information System (GIS) data sets to determine the extent to which flora and fauna related features (entities), attributes, and domain values could potentially be incorporated into the SDS/FMS. The following data sets evaluated under this project, were selected by The CADD/GIS Center and through collaboration with Baker based on the 60% submittal:

- Eglin Air Force Base
- Aberdeen Proving Ground
- Patuxent River Naval Air Station
- Camp Pendelton
- USACE Walla Walla District
- Integrated Taxonomic Information System (IT IS)
- U. S. forest Service – Forest Inventory and Analysis Data Base Retrieval System

- USDA PLANTS National Database

Applicability

This report is applicable to the Department of Defense (DoD) project management and technical design personnel involved in the procurement of environmental services from GIS contractors of the development of SDS/FMS compliant databases. Likewise, this report would also be useful to contractors who are involved with the development of SDS/FMS complaint environmental databases for DoD organizations

Background

As more environmental clean-up and restoration projects within the DoD begin to take advantage of the capabilities of GIS, the use of the environmental portions of the SDS/FMS have been increasing. GIS has been used for more than a decade by planning professionals, landscape architects, and those in forestry and wildlife management agencies. In addition, numerous databases exist to capture and manage flora and fauna data. Federal agencies throughout the Federal Geospatial Data Committee (FGDC) are currently developing standards for metadata, taxonomy, and vegetation. Geospatial standards developed by these agencies may be valuable for inclusion into the SDS/FMS. Knowledge of available databases may also be critical when developing or modifying geospatial standards.

2 Purpose and Methodology

Project Goals

The goals for this project can be summarized as follows:

- To review and evaluate selected GIS data sets to determine the extent the flora and fauna related features (entities), attributes, and domain values could be incorporated into the SDS/FMS release 1.8.
- To present spreadsheet printouts addressing the existing SDS/FMS release 1.8 Flora and Fauna Entity Sets graphic and non-graphic geospatial schema (i.e., entity types/entities attribute tables, attributes, and domain tables/domain categorized by Entity Sets and Entity Class.
- To present recommended additions to the existing SDS/FMS release 1.8 Flora and Fauna Entity Set based on the review and evaluation of the selected GIS data sets.

Research Processes

Project research involved a search of Internet resources and telephone interviews with agency representation identified by The CADD/GIS Center or during the Internet search. Applicable documents were downloaded form the Internet or hard copies were mailed b the agency representatives. The documents were reviewed and then the appropriate persons were contacted to obtain follow-up information or clarification, if necessary.

The following criteria were used to determine which portion of the above-referenced data sets are recommended for incorporation into SDS/FMS:

- The data needs to be general enough to be used at different DoD facilities. In some cases, the data sets were very specific (i.e., wood duck nests) which were not recommended for incorporations into SDS/FMS. However, some of the attributes from the specific data sets (i.e., number of eggs) were recommended for incorporation into SDS/FMS attribute tables.
- The tables and/or attributes need to have definitions to determine if they may be appropriate for incorporation into SDS/FMS. In some cases, the definitions could be determined based on the attribute names, or other definitions could not be determined.

3 Research and Evaluation

The following sections present a detailed discussion of the above-mentioned data sets evaluated, the persons contacted for information (and their phone numbers), and a brief discussion concerning the scope and organizational structure of each data set that was reviewed.

Existing SDS/FMS Release 1.8 Flora and Fauna Data Structure

This first part of the evaluation involved generating spreadsheets presenting SDS/FMS entity set structure for release 1.2 flora and fauna entity sets (Appendix A). Then spreadsheets were generated depicting the present version, release 1.6, of the SDS/FMS (Appendix B). The differences between the two SDS/FMS releases are primarily in the naming convention. In release 1.2, the Flora Entity Set was called *Botany* and the Fauna Entity Set was called *Wildlife.* Entity Class nomenclature has also been changed to reflect the scientific and management terminology. By restructuring the *Botany* and *Wildlife* entity classes into a scientific divisions, a more accurate reflection of the scientific classifications is provided the users and the SDS/FMS will be more readily useable by the various scientific communities' existent upon installations. Appendix C presents the SDS/FMS release 1.8 data structure for flora, fauna and wetland entity sets, respectively. Each of these appendices contains the following tables:

- Entity Types and Class Names
- Attribute Table Names
- Attributes for each Attribute Table
- Domain Table Names
- Domain Values

These tables were exported from Microsoft Access into Microsoft Excel and were revised slightly in format for ease of comprehension by the reader. Some of the columns were deleted so that only the pertinent information would be presented. These tables were generated by Baker to summarize the attributes that were used in each table, since many tables had the same attributes. Symbology was not discussed in this research effort due to a concurrent effort of The CADD/GIS Center. SDS/FMS release 1.4 was reviewed during this research effort. Determination was made that there were no changes reflected in the 1.4 that were not found in release 1.2. Therefore to demonstrate the changes that that flora and fauna entity sets have undergone, only releases 1.2, 1.6 and 1.8 were used.

Review and Evaluation of Existing Flora and Fauna GIS Data

Eglin Air Force Base

Mr. Ken Bristol (850-882-6397) from Eglin Air Force Base was contacted to obtain the Eglin flora and fauna data sets and data dictionary. A spreadsheet summary was developed for the data dictionary. The data set contains the attribute table names and attributes. There are no domain values or domain definitions associated with these data sets. The data sets were sent in a format that did not include either attribute table definitions of attribute definitions. There were no domain tables presented in the data sets. Eglin attribute tables maintain a many-to-one relationship with the graphical applications, which are conducted primarily in MicroStation.

Mr. Bristol indicated that the information in their data dictionary is very “site specific” to the studies conducted at their installation and may not be appropriate for inclusion into the SDS/FMS. Eglin natural resources are collected and maintained for use by two separate divisions. One division is the Natural Resources Division and the other being the Civil Engineering Division. The data present in this document was provided by the Civil Engineering Division is based primarily on the Base Comprehensive Plan.

Eglin in totality manages over 460,000 acres. The Base Comprehensive Plan only pertains to approximately 10,000 acres under Eglin’s Natural Resource Management. The remaining 450,000 plus acres are a reservation for Natural Resource Conservation. The database schema for the Natural Resource

Reservation contains species specific data pertaining to the varying species of flora and fauna. BGRI found several attribute tables and attributes that would enhance the SDS/FMS flora and fauna entity sets. These attribute tables and attributes are listed in Appendices N and O, respectively.

Aberdeen Proving Ground

Michael Baker Jr., Inc., was contacted to obtain the latest version of the Aberdeen Proving Ground (APG) data dictionary. Michael Baker Jr., Inc., is the primary contractor at APG developing a facility-wide GIS. The printout of this data dictionary is presented in Appendix E. The data set consists of Entity Classes, Entity Names, and Entity Types and are identical to those in the SDS/FMS version 1.8 with the exception of a few minor modifications found in the entity names.

APG used the SDS/FMS as a template for its attribute tables with specific modifications based their site-specific data needs. For example, the SDS/FMS attribute table *famgtbuf* contained data about the fauna habitat buffer zones for Bald Eagle nests and roosts. The attributes in the APG attribute table *famgtbuf* are based primarily on the SDS/FMS with only two new attributes added for support of their specific installation. In addition, definitions have been modified to include the specific needs of the base. The new APG data set included a few attribute tables that do not exist in SDS/FMS. These additional attribute tables were reviewed for possible inclusion into the SDS/FMS and can be found within the Appendices N and O, respectively.

According to Ms. Diedre DeRoia (410-278-0536), APG has considered the Land Condition-Trend Analysis (LCTA) Data Dictionary into its database. The U. S. Army Construction Engineering Research Laboratories as a standardized method of natural resources data collection, analysis and reporting developed the LCTA. The LCTA has not been added to the APG database so the LCTA was not reviewed as part of this deliverable.

Paxtuent River Naval Air Station

Mr. Bobby Bean (301-757-1700) form Patuxent River Naval Air Station (PAX) was contacted to obtain their data dictionary. The data

dictionary was reviewed to determine which databases within their data set contained flora or fauna data. Appendix F presents the flora and fauna attribute table, attributes, descriptions and associated information. Appendix G presents the descriptions of all the Patuxent River attribute tables. The tables that are included in Appendix F are noted in bold on Appendix G. A few of the attribute tables appear to be based on SDS/FMS. Therefore, the attributes within these tables were compared to SDS/FMS in Appendix G, which also provides a matrix correlation between the SDS/FMS. Recommendations are also found within Appendix G.

Camp Pendelton

Mr. Jay Cary (760-725-9749) from Cap Pendelton provided BGRI with the Camp Pendelton GIS Conceptual Design Draft. This Design Draft indicated the Camp Pendelton data dictionary was compared to SDS/FMS release 1.6 in 1997. Appendix F presents the excerpt of the GIS Conceptual Design Draft that details this comparison. The Design Draft also includes potential graphical standards and recommendations for Camp Pendelton to develop their database. Because the Camp Pendelton data dictionary was previously compared to the SDS/FMS for the development of the Camp Pendelton Design Draft, a comparison to the SDS/FMS was not conducted for this deliverable.

The Design Draft presented the Entity Type Names and definitions from the SDS/FMS that were recommended for inclusion into the Camp Pendelton database. The Design Draft also presented recommended Entity Type Names and definitions that were not included in the SDS/FMS release 1.6. The Design Draft does not include any recommendations for Attribute Tables, Attributes or Domains. The recommendations from the Conceptual Design Draft have not been incorporated into the Camp Pendelton database at this time.

BGRI requested that Mr. Cary send a copy of the database schema as it existed prior to the development of the Conceptual Design Draft. This database schema will provide BGRI with the attributes and definitions needed in the evaluation of the data model. Mr. Cary indicated in a letter that the database schema could not be reproduced in any fashion. Recommendations as to the use of any

data found in the Camp Pendelton database schema can be found in Appendices N and O of this document.

USACE Walla Walla

Mr. Blaise Grden (509-527-7271) from WSACE Walla Walla District was contacted for information on their data dictionary. He indicated that they are trying to follow the SDS/FMS. He also indicated that they would send BGRI some information regarding their data dictionary; however, no information has been received to date. Mr. Grden stated in a later conversation that he participated with the initial SDS/FMS design and development committee and would resume indirect involvement.

Review and Evaluation of Exiting Flora and Fauna GIS Databases for Geospatial Requirements

Integrated Taxonomic Information System (ITIS)

Information on the Integrated Taxonomic Information System (ITIS) was obtained from the Internet address *http://www.itis.usda.gov/itis*. Appendix H contains general information on the ITIS that was downloaded via the Internet including the Taxonomic Workbench Users Guide. Mr. Gary Waggoner (303-202-4222) at the U. S. Geologic Survey (USGS) Center for Biological Information in Denver, Colorado, and Ms. Barbara Lamborne (202-260-3642) from Environmental Protection Agency (EPA) were contacted to discuss ITIS.

The ITIS was created to improve the organization of, and access to, standard taxonomic nomenclature. The goal of the ITIS is to create an easily accessible database with reliable information on species names and their hierarchical classification. The ITIS includes documented taxonomic information of flora and fauna from both aquatic and terrestrial habitats.

The goal of ITIS database is to form partnerships between taxonomic list development efforts. The ITIS has formed partnerships with several agencies that manage taxonomic databases that contribute significantly to ITIS. The USGS, Biological Resources Division (BRD) Survey Project developed a checklist of vertebrates of the U. S., the U. S. Territories, and Canada. BRD continues to

maintain the list. The ITIS will include an update of the original checklist, to which freshwater fish have been added.

The National Oceanographic Data Center (NODC) Taxonomic Code is a system of numerical codes used to represent the scientific names of organisms chiefly in support of archiving oceanographic data. The ITIS also will incorporate all the NODC data into its database. The PLANTS database is the plant data standard for the ITIS. PLANTS database is presented in more detail in the following section of this report. In addition to the above partnerships, several specialists contribute data and expertise, and are responsible for overseeing changes and additions to the ITIS database.

Mr. Waggoner and Ms. Lamborne both indicated that they would not recommend incorporating the ITIS into the SDS/FMS. Due to the amount of data and the dynamics of the database, the ITIS is a constantly changing database, which currently is updated almost monthly. They stated that incorporating time consuming effort to incorporate ITIS into the SDS/FMS would be fruitless because the data would be out dated. In addition, the database would become too large since the data consists primarily of individual plant and animal species that reside within the U. S. Therefore, it is recommended that a reference should be added to the SDS/FMS to refer users to the ITIS web site for the most current taxonomic information.

Forest Inventory and Analysis Data Base Retrieval System

Information on the Forest Inventory and Analysis Data Base Retrieval System (FIA) was obtained at the Internet address *http://www.srsfia.usfs.msstate.edu/.* Appendix I contains general information about the FIA from the aforementioned Internet site. Mr. Brad Smith (202-205-0841) from the U. S. Forest Service was contacted to discuss the FIA. Mr. Smith stated that the FIA monitors forestland across the U.S. including forest on both public and private lands. Currently, there are two primary databases being used by the FIA. These two primary databases are called the Eastside and the Westside Forest Inventory DataBase User's Manuals. In addition, other groups are collecting similar information. Appendix J contains copies of both manuals and Appendix K provides a spreadsheet summary of the Eastside and Westside databases.

The U. S. Forest Service (USFS) is under a mandate from Congress to create a Core Manual for collecting data to ensure that agency and organizations are using the same methods to collect and store data. The mandate requires the USFS to have the manual completed by the end of this calendar year. Mr. Smith said that the FIA should be incorporated into the SDS/FMS because many DoD facilities have large forest areas. However, he indicated that the FIA should not be incorporated into the SDS/FMS until the Core Manual is completed, since the Core Manual would be the new standard in use at the USFS.

PLANTS

Information on the *PLANTS* National Database was obtained at Internet address *http://plants.usda.gov*. Appendix L contains general information concerning the web site and the database *PLANTS*. M. Phil Smith from the Natural Resources Conservation Service (NRCS), formally known as the Soil Conservation Service, Department of Agriculture, was contacted on recommendation for obtaining a copy of the *PLANTS* data dictionary. Mr. Smith indicated that in addition to the *PLANTS* database, the NRCS maintains a separate database called The Vegetative Practice Design (VegSpec). The VegSpec is actually a separate database from *PLANTS*, although some people may consider it a part of the *PLANTS* database model. VegSpec does contain some similar information to the *PLANTS* database, VegSpec, however is a more detailed database than the *PLANTS* database. Appendix M provides general information about *PLANTS*.

The *PLANTS* database is managed by the NRCS, National Plant Data Center, Baton Rouge, Louisiana, and includes all native or naturalized vascular plants, mosses, lichen, liverworts and hornworts known to occur in the U. S. The *PLANTS* database provides individuals with standardized plant names, symbols, and other plant attribute information.

Several federal agencies are using *PLANTS*, including the National Park Service (NPS), the Natural Resource Conservation Service (NRCS), the Smithsonian Institution, and the Fish and Wildlife Service (FWS), to name a few. *PLANTS* is the plant data standard used I the development of the IT IS. Since *PLANTS* is incorporated in the ITIS, the above recommendation to reference the

ITIS database with the SDS/FMS will also include the *PLANTS* database model.

The VegSpec contains data pertaining to plant attributes (i.e., tolerance to anaerobic conditions, resistance to burning. The VegSpec contains more than 100 of these attributes for each of the more than 20,000 plant species. Because the majority of the database attributes is specific to each plant, and is not the type of data that are typically collected at sites, it is not recommended to include the VegSpec data in the SDS/FMS. Mr. Phil Smith from the NRCS indicated that one useful piece of information that should be collected when plant surveys are conducted should be the NRCS soil map unit. A summary spreadsheet was developed for recommending the inclusion of the soil map unit of NRCS in the SDS/FMS flora and fauna entity sets. This spreadsheet summary can be found in Appendix M. A lot of information can be obtained from using the soil map unit that could help the NRCS further define some of the plant attributes.

4 Recommendations

Appendices N and O provide recommendations for additional entity types, entities, attribute tables, attributes and domains that could be added to the SDS/FMS from this research process. BGRI provides recommendations for additional entities and entity types into the SDS/FMS in Appendix N. Appendix O provides recommended attribute tables and/or attributes. Domain tables and Domain values are listed in the spreadsheet of Appendix P. Please note that these appendices merely suggest the addition of new graphic and non-graphic tables to the flora and fauna entity sets.

It is the opinion of BGRI that management tables should be created from each of the taxonomic divisions of fauna. Management practices and procedures are extremely different between birds (Aves) and bears (Mammalia). With the large amounts of data gathered during the differing management procedures, the one management attribute table would become too large for efficient use. Also, another consideration would be that several to many records within the attribute table would remain empty.

BGRI also suggests redefining a domain table found within the Flora entity set. Found in the attribute table *flmgtfst*, the attribute *for_typ_d* is defined as “a descriptor of the forest type.” The domain table *d_fortyp* contains domain values that define the forest type as an analysis plot, a compartment, a forest plot, a forest stand, and to be determined. It is the recommendation that the attribute *for_use_d* and a newly created domain table *for_use_d* would better accommodate the domain values listed in *d_fortyp*. Appendices O and P suggest and more accurate listing of domain values for the attribute *for_typ_d* and the domain table *d_fortyp* as found in the attribute table *flmgtfst*.

BGRI would also like to recommend redefining the Entity Classes of the Flora and Fauna Entity Sets. This recommendation is based on the fact that end-users may not be familiar with the scientific terminology and scientific divisions that is presently in use in SDS/FMS release 1.8. BGRI suggests redefining the Entity Classes of flora and fauna for end-use comprehension. Appendix Q provides suggestions for redefining the Entity Classes in Flora and Fauna entity sets.

Appendix A
Overview of SDS/FMS Release 1.2 Flora and Fauna Entity Sets

Appendix B
Overview of SDS/FMS Release 1.6 Flora and Fauna Entity Sets

Appendix C
Overview of SDS/FMS Release 1.8 Flora and Fauna Entity Sets

Appendix D
Eglin Air Force Base Natural Resources Data Dictionary

Appendix E
Aberdeen Proving Ground GIS Data Set

Appendix F
Patuxent River Naval Air Station
Flora/Fauna Data Sets

Appendix G
PAX River and SDS/FMS Flora/Fauna Matrix Correlation

Appendix H
Integrated Taxonomic Information System (ITIS) Documentation

Appendix I
Forest Inventory and Analysis (FIA) General Information

Appendix J
Forest Inventory and Analysis (FIA) Eastside and Westside Database Users Manuals

Appendix K
Forest Inventory and Analysis (FIA) Summary Spreadsheets

Appendix L
PLANTS Version 2.0 Documentation

Appendix M
Soil Map Unit Spreadsheet

Appendix N
Recommended New SDS/FMS Entity and Entity Types

Appendix O
Recommended New SDS/FMS Attribute Domain Tables

Appendix P
Suggested Entity Class Definition Modifications